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PROVISIONAL APPLICATION FOR PATENT COVER SHEET

This is a request for filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR 1.53(c).

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☐ Additional inventors are being named on the _____ separately numbered sheets attached hereto

TITLE OF THE INVENTION (500 characters max)

Techniques for labeling of plastic, glass or metal containers or surfaces with polymeric labels employing an activated hydrophilic adhesive layer

Direct all correspondence to:

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5 TECHNIQUES FOR LABELING OF PLASTIC, GLASS OR METAL
CONTAINERS OR SURFACES WITH POLYMERIC LABELS EMPLOYING AN
ACTIVATED HYDROPHILIC

FIELD OF THE INVENTION

10 This invention relates to polymeric sheets or rolls
particularly adapted for use as labels in the post mold
labeling of plastic, glass or metal containers or surfaces.
More particularly, the present invention relates to
polymeric film substrates adapted for printing that also
15 have a hydrophilic surface layer activatable into an
adhesive layer for use as labels in post mold labeling
applications using conventional wet applied water based
labeling equipment typically used for the application of
paper labels. In another aspect the invention relates to
20 such labels which possess the beneficial properties of the
known plastic label substrates, but which are able to be
applied on conventional post mold paper labeling equipment
using wet applied water based solutions comprising water,
water blended with a selected cross-linking agent, adhesives
25 or adhesives blended with a selected cross-linking agent.

BACKGROUND OF THE INVENTION

Plastic and glass containers or bottles are prevalent in a
30 wide variety of shapes and sizes for holding many different
types of materials such as detergents, chemicals, motor oil,
beer, etc. These containers are glass or plastic (mono or
multi layers) of polyethylene, polypropylene, polyester or
vinyl along with other specialty blends for specific barrier
35 and product resistance performance. Generally such
containers are provided with a label which designates the
trade name of the product and may contain other information
as well. The early art which still is prevalent today
employed the use of labels manufactured from paper

5 substrates that were applied with a water based adhesive.
Subsequently, dry pressure sensitive self adhesives and in
mold labels manufactured from paper have been and continue
to be used. The shortcomings of paper labels with regard to
tearing, wrinkling, creasing and the like due to age and
10 moisture, or due to a lack of deformability when applied to
a deformable plastic substrate have been well documented in
the labeling industry. Because of this and the need to
produce recyclable plastic containers, over the years a
great deal of effort has been expended to develop container
15 decoration techniques and durable film substrates which
would overcome these shortcomings.

Polymeric film facestocks for container decoration which
have resulted from these efforts can be applied to glass and
20 plastic containers as self adhesive pressure sensitive
labels as described in the prior art. The use of self
adhesive paper and film "pressure sensitive adhesive" (PSA)
labels that have been preprinted and supported on a release
liner is not a cost effective option because of the added
25 cost of the release liner used to support and render
processable the self adhesive face stock. The cost of this
type of structure combined with the added cost of disposal
of the liner does not make pressure sensitive labeling a
desirable option from an economic or environmental
30 standpoint for high volume applications. In addition, PSA
labelers typically run much slower than cold glue labelers
and capital investment in new labeling equipment is required
to transition from wet applied Post Mold Labels (PML) to
self adhesive PSA labels. Also a factor is the effect of a
35 new process on an existing packaging line in terms of
learning cure and experience.

Another film face stock labeling technique that has evolved
is the use of heat activated in-mold labels as described in
40 the prior art where a preprinted plastic label with a heat

5 activated adhesive is placed in the mold before the molten plastic resin is injected or blown into the mold cavity at elevated temperature and pressure which activates the adhesive and fuses the label substrate to the container in-mold resulting in a pre-decorated container as it exits the
10 mold. The use of polymeric film based in-mold label substrates presents a more cost effective alternative than self adhesive pressure sensitive labels in terms of substrate cost but as this technology has progressed, it has been found that productivity is impacted by the label
15 feeding step into the mold which is performed in a complex, continuous and rapid manner which results in large amounts of scrap material. Also, the initial capital investment required to tool up for a container specific in-mold label process for new molds and the complex electromechanical
20 maintenance intensive feeding devices is significant. Another detriment for this process is the potential inventory carrying costs for varieties of labeled containers that come into play with predecorated containers such as in-mold for those who would choose to apply the label
25 immediately pre or post filled.

Post mold decoration of glass and plastic containers in the current art can also be accomplished by direct screen printing on the container. Direct screen printing on the
30 container is not a cost effective process and also presents the aforementioned inventory problems along with added cost for freight to and from a screen printer. The graphical possibilities for label copy are limited in terms of cost and quality with this technique. Commodity products can not
35 support the cost of this labeling technique.

Another post mold technique that has been popular is the "Therimage" process. This process transfers a reverse printed image from a transfer release sheet under
40 temperature and pressure to produce decorated containers.

5 The "Therimage" technique of transferring a reverse printed
image is costly because of transfer sheet costs and presents
the same disposal problems and costs with the transfer sheet
as occurs with the aforementioned release liner used in
10 conjunction with self adhesive labels. Graphic design and
quality is limited with this technique.

Other techniques for labeling various plastic and glass
containers with preprinted paper or film label substrates
include the use of hot melt adhesives (not aqueous) which
15 are applied to the label substrate or container in a molten
state with container and substrate subsequently married
while the hot melt is molten. When the hot melt adhesive
cools, it sets up and bonds the label substrate to the
container. This technology requires the use of
20 sophisticated melting and application equipment that must be
operated, cleaned and maintained at elevated temperatures.
This technology works well with complete 360 degree wrap
around labels but has not evolved to the point to allow
consistent labeling of a die cut or square cut label with
25 less than 360 degree wrap. Affixing a cut label to an area
on a container with 100% or patterned adhesive application
using hot melt adhesives has not been commercially
perfected. Complete wrap around hot melt applied labels
where one end of the label is affixed to the container while
30 the other end is wrapped around the container and affixed
with hot melt to the label substrate is proven hot melt
label application technology that works well for film and
paper label substrates. This technology does not fit for
individually labeled panels on a container such a
35 rectangular oil, contoured detergent or beer containers
where discrete labels are applied such as a neck label,
front label or rear label that are not wrapped around 360
degrees. Another drawback is the added cost for label
substrate when this technique is used since more label
40 substrate is required because of the 100% wrap around.

5

Lastly, one of the oldest and still prevalent labeling techniques is the application of paper based labels to glass and plastic containers using natural and synthetic labeling adhesives such as BL300 produced by Henkel Adhesives or
10 OC363-20 produced by O.C. Adhesives Corp. which are known in the art. This is a safe (water based) proven technology that has grown and been employed for many years and consequently there are many existing machines that have been installed for this type of labeling technique such as from Krones,
15 Neutraubling, Germany that run cut precut labels or Koyo, Japan which runs roll stock that is cut on machine to the label size. The cut label techniques and associated adhesives work well with paper based substrates applied to glass, plastic or metal containers because the wet adhesive
20 wicks (absorbs) into the paper substrate from the applicator roll, pad or pallet which breathes and allows the moisture from the water carrier to be absorbed by and dry thru the paper base.

25 This technique obviously will not work well with non-porous polymeric substrates as the adhesive can not wick into the polymeric substrate for initial tack and adhesive transfer to the label or drying thru the plastic. Typically, wet applied cut label machines work where glued pallets remove
30 the label out of the label holding magazine while simultaneously gluing the back side of the label. This is accomplished by applying a thin glue film to the pallet in a pattern or with 100% coverage which is then pressed in intimate contact against the first label in the stack.

35

After its removal, the label sticks on the entire glued area of the pallet until transferred to a "gripper" cylinder and removed from the pallet typically using a vacuum mechanism. The gripper cylinder then transfers the label to the
40 container to be labeled. The various machine designs and

5 techniques are well known within the labeling industry and to those skilled in the art. The "Krones Manual Of Labeling Technology" by Hermann Kronseder dated December 1978, is hereby incorporated by reference.

10 In recent years, as described in U.S. 6,663,746 and 6,517,664, which are incorporated by reference, polymeric film labels using a hydrophilic glue receptive layer and a water based adhesive composition are now being used. The applications also describe the concept of rewetting the hydrophilic layer with an aqueous medium (water or adhesive
15 that may contain a cross-linking agent) to activate the hydrophilic layer into an adhesive layer.

Attempts have been made to use polymeric substrates with high moisture vapor transmission rates (MVTR) and tacky or pressure sensitive adhesive on conventional labeling
20 equipment with little success. The tacky adhesive required to stick to the water impervious polymeric substrate causes machining problems by gumming up the adhesive application system and creates cleanup issues. The high MVTR substrates also did not have good wet tack with existing commercially
25 available adhesives that would machine without problems and did not dry rapidly enough making the labels prone to "swimming" or moving from the desired application area during down stream processing. In addition, the adhesives do not wet out and apply uniformly to non hydrophilic surfaces
30 with the crude adhesive metering and application systems currently in use on existing paper labeling machinery. Without uniform application, wet out and wet tack, it will be impossible to apply a clear label that has the no label look because of adhesive and application imperfections.
35 Recent developments in radiation curable (not aqueous) adhesives adapted for use on cut and stack labelers referenced in issued and pending patent applications to McNutt et. al. have led to the development of more

5 sophisticated adhesive metering mechanisms and label wipers
and techniques that can be used to uniformly control
adhesive deposition and these modifications are contemplated
for use to apply the aqueous activation medium to the
activatable layer of the current invention at the minimum
10 possible level.

The techniques of U.S. 6,517,664 and U.S. 6,663,746 which are
now being performed commercially and those developed by
McNutt et al use adhesives applied to the polymeric film on
the labeling machine to affix the label to the container and
15 work well for opaque labels. There are still inconsistencies
and imperfections in the application of the adhesive such as
bubbles and heavy or light adhesive areas that when applied
to clear or contact clear substrates appear inferior when
compared to PSA labels where the adhesive has been pre-
20 coated on the substrate. In addition, the radiation curable
adhesives as defined by McNutt et. al. are very costly when
compared to aqueous systems and in comparison are health and
environmental unfriendly.

25 Accordingly, it is an object of the invention to provide a
polymeric label particularly adapted for use in post mold
wet applied labeling of polymeric, glass and metal
containers that has a dry non pressure sensitive hydrophilic
layer uniformly pre-applied that can be activated into a
30 defect free adhesive layer. This is accomplished by pre-
applying by coating, coextrusion or extrusion the layer that
is activated on the labeling machine with an aqueous medium
to become tacky and function as an adhesive to affix the
polymeric label to the container. The activated label will
35 readily feed from the label magazine or gripper, adhere with
sufficient tack without moving through post labeling
handling and processing including but not limited to
conveying, filling, case packing and palletizing.

5 It is a primary object of the invention to provide a
polymeric label with a pre-applied hydrophilic layer
consisting of at least 30% dry by weight of animal glue
activated into an adhesive layer through an aqueous medium
on the labeler particularly adapted for use in post mold wet
10 applied labeling of polymeric and glass containers that
would have sufficient wet tack and affinity for water, a
water based solution or adhesive used to allow for transfer
of the water, water based solution or water based adhesive
to the polymeric label substrate from the applicator
15 roll(s), pad(s) or pallet(s) of the labeling machine to
activate it into an adhesive.

It is also an object of the invention to provide an
activatable polymeric label for use in post mold wet applied
20 labeling of polymeric and glass containers that would have a
coefficient of expansion or contraction under the conditions
which the container sees which is the same or compatible
with that of the polymeric resin, glass or metal from which
the container is made so that expansion and contraction of
25 the container will not wrinkle or otherwise affect the
integrity of the label.

It is also an object of the invention to provide a polymeric
label for use in wet applied post mold labeling which would
30 combine suitable properties of modulus of elasticity and
flexibility and would not be degraded by handling and
flexing of the subsequent container. Finally, it would be
desirable to provide a label for use in wet applied post
mold labeling of polymeric containers which does not have to
35 be removed from such containers in order to recycle or
regrind defective or post consumer polymeric containers.

SUMMARY OF THE INVENTION

5

In considering the performance or economic shortcomings of prior art materials, I have discovered an improvement to the process as described in the pending and issued applications by the applicant as cited above by which a polymeric label
10 with a uniform pre-applied hydrophilic layer comprising at least 30% by dry weight of a animal glue can be activated into a tacky adhesive when wet on the labeler by an aqueous medium and applied to a glass, plastic or metal container or surface in a more consistent and uniform manner than a label
15 with a non activatable layer that requires a heavy adhesive layer applied on the label machine to function, said method comprising:

- 20 (a) applying a uniform layer of a hydrophilic solid material based on animal glue or a to a polymeric label to form an activatable hydrophilic layer on said polymeric label that can be activated into a tacky adhesive;
- 25 (b) applying a light deposition water, water containing a cross-linking agent, a water based adhesive or a water based adhesive containing a cross-linking agent over said activatable hydrophilic layer to form a tacky fastenable polymeric label free of bubbles and uneven adhesive streaks typical of the standard deposition of adhesives applied on
30 aqueous labelers;
- (c) fastening said fastenable polymeric label to a glass, plastic or metal container or surface; and
- 35 (d) curing said polymeric label on said glass, plastic or metal surface or container.

For opaque or metalized labels, special mention is made that it is preferable to use a coextruded polymeric label

5 substrate with a cavitated or voided adhesive surface
producing micro-voids or pores on the adhesive side in
combination with a porous core. Typically these types of
label substrates have a density <0.9 where the adhesive
penetrates the rear plane of the label wherein said polymer
10 label contains a portion of said dried water based adhesive
within said voided or cavitated polymer label.

The use of the low density micro-voided polymer film can
allow portions of the water based adhesive to migrate into
15 the film during the drying cycle to provide an enhanced bond
between the polymeric label and the container surface and to
also impart stiffness to the dried label on the container
surface. Additionally, the weak internal strength of the
voided material provides the appearance of superior bond
20 when it is attempted to remove the label because it
fractures apart at minimal force. Additionally, the pores
create greater surface area for bonding versus a polymeric
film with a smooth adhesive surface.

Most importantly, it has been found that voided substrates
25 with a porous adhesive side that are judiciously applied
with a hydrophilic layer on the adhesive side show superior
adhesion when rewet and pressed onto the glass metal or
plastic container because the voided area or open area of
the pore has a greater surface area than a non voided smooth
30 surface and appears to act as a suction cup when the air in
the cavitated or voided area is pressed out as the label is
applied providing an improved bond while pulling activating
aqueous medium into the pores.

35 DETAILED DESCRIPTION OF THE INVENTION

Pre-applied activatable hydrophilic materials containing
animal glue that can function as an adhesive are formulated

5 so that their coefficients of expansion or contraction,
thickness and modulus of elasticity when applied to a
polymer film will result in a polymeric film facestock that
will have hydrophilicity, absorbtivity, wet tack and drying
properties that will permit the polymer film to be applied
10 to polymeric, glass or metal containers via water based wet
labeling techniques on standard paper labeling equipment.
The apparatus which is used to apply paper labels is well
known to those in the art. The polymeric label substrate
with the activatable hydrophilic layer will demonstrate
15 sufficient "wet tack" during the label application period
and the label drying period to permit containers to be
handled and processed. The polymeric film based facestock
will provide a label with printability, chemical and
dimensional stability, resistance to cracking, tearing,
20 creasing, wrinkling or any other degradation of the sort
experienced by paper labels due to physical or environmental
extremes.

The invention also permits the use of hydrophilic layer
25 activatable by a water based solution into an adhesive to be
used to fasten a clear or contact clear polymeric film
substrate which is reverse printed and then over coated with
the activatable hydrophilic layer to a container. As used
herein the reference to a "container" includes a surface of
30 an object made of glass, plastic or metals such as bottles,
cans, toys and building materials.

The activatable hydrophilic component or blends containing
animal glue will be applied in the present invention to the
35 selected polymeric sheet in a continuous or patterned layer
to provide the absorptive, wet tack and drying properties
that are necessary to enable polymeric sheets to be
successfully used as label substrates on polymeric or glass
containers when activated through wetting with water, water
40 and a cross-linker, adhesive or adhesive and a cross-linker

5 using water based wet labeling techniques where the
apparatus is configured to apply the minimum amount of
aqueous solution to activate the layer into a tacky adhesive
when wet, but not excess aqueous medium to saturate the
activatable layer causing it to loose its adhesive
10 properties and not adhere well and take a long time to dry.
The activatable hydrophilic layer, containing at least 30%
by weight of animal glue which may be applied by either a
coating, coextrusion or an extrusion technique, has the
function of absorbing moisture to activate the layer as an
15 adhesive when wet with an aqueous medium thus causing
selected hydrophilic layers to function as an adhesive
without any applied adhesive as is conventionally performed
on aqueous labeling machines in the art or to activate by
absorbing the moisture from an aqueous adhesive if used, to
20 cause the polymer film to adhere to the glass, plastic or
metal container and to set up rapidly and positively. Key to
this invention is the minimization of the aqueous medium
used to activate the hydrophilic layer as an adhesive.
Excess activation moisture can decrease the tack of the
25 activated layer as it becomes saturated with moisture and
will lead to longer drying times and loss of adhesion
properties.

It is also possible to coextrude the activatable hydrophilic
30 layer with the polymer film layer.

The choice of polymeric substrate for the label film will
determine the rigidity, deformability or conformability,
regrindability, printability and expansion or contraction
35 characteristics required for application to the selected
container without the problems associated with paper labels.

In addition, the polymeric film substrate for the label will
be selected so that it will expand or contract to the same
40 degree as the container so that when ambient conditions

5 change, the label will not pucker or blister.

The polymeric materials include clear, opaque or colored polypropylene, polyethylene, polyester, polystyrene, polycarbonate, vinyl, cellophane or compatibilized blends.

10

The term "film facestock" or "polymeric label substrate" as used herein should be taken for purposes of the present invention to refer to a material compatible in terms of rigidity, deformability or conformability, recyclability if a plastic container and expansion or contraction characteristics with the plastic or glass container to be labeled. Similarly, the "activatable hydrophilic layer" previously mentioned has the properties of minimal tack when dry so labels can be unwound from a roll or separated from a stack and once activated with moisture, it will have the properties of wet tack, absorbtivity, drying, sufficient adhesion to the polymeric label substrate and affinity and adhesion to the container or labeling adhesive if used as an activating medium in the wet or dry form.

25

Activatable hydrophilic layers containing animal glue can be wet or remoistened without adhesive for use on a glass, plastic or metal container or a water based adhesive can be used to activate and affix the polymeric label substrate with the activatable hydrophilic layer to the glass, plastic or metal container. For deformable containers, the hydrophilic layer activated into an adhesive is formulated to form a bond with the container and the polymeric film substrate such that when dry, the strength of the container wall-hydrophilic adhesive interface and the cohesive strength of the adhesive itself are all greater than the forces required for deformation of the label.

35

As used herein and in the appended claims, the term "hydrophilic" is used to describe materials or mixtures of

40

5 materials which bind, pass or absorb water. The term
"activatable hydrophilic layer" describes a hydrophilic
layer that when binding, passing or absorbing water becomes
activated and transforms into an adhesive layer with wet
tack and affinity for the container to be labeled. The term
10 activated as used herein describes the change in a dry pre-
applied dry hydrophilic layer on a label substrate to a wet
adhesive layer when activated with an aqueous medium that
will adhere to the container wall to be labeled, dry and set
up with strong adhesion.

15 The preferred "activatable hydrophilic" materials of the
present invention are based on animal glue coating which in
broad terms is an organic colloid of protein derivation from
collagen which is a protein constituent of hide materials
20 and bones obtained using well know techniques widely used to
provide many commercially available glues. Hide animal glue
is preferred over bone animal glue because of superior
physical properties and strength. The animal source is not
critical and glues may be derived from wild or domesticated
25 animals such as horses, cattle, pigs, sheep and the like.
Purified versions of animal glue are also known as gelatin.
Animal glues are commonly graded on comparative gel gram
strength values by manufacturers and provides a rough guide
for use but this standard does not always measure their
30 working qualities as adhesives for glass, plastic and metal
containers. Considerations of gram strength, pH, ash
content, clarity, grease content, type of glue (bone of
hide), degree of purification and processing methods all
have a bearing. The gram strength measurement of animal glue
35 is also known as a gel strength measurement which ranges
from about 30 grams (weak) to 500 grams (exceptionally
strong) where the highest gram strengths contain greater
amounts of reactive glue protein. Typically, stronger
adhesive bonds are achieved with higher gram strength animal
40 glues and blends of animal glues. Unfortunately, as gram

- 5 strength increases, so does the dry brittleness of the glue which must be addressed in formulating using modifying components such as plasticizers, humectants and modifying synthetic resin dispersions.
- 10 In physical form, dry animal glues are odorless, relatively tack free hard materials ranging in clarity from light amber to dark brown depending on the origin, processing technique and degree of purification that contain 10 - 14% moisture. Almost all grades can be made up into aqueous solutions and
- 15 many can be melted and applied at temperatures less than the boiling point of water such as through a die or extruder as long as it is vented for potential moisture that could flash off. For a clear polymeric substrate, clarity or contact clarity of a thin activatable hydrophilic layer comprising
- 20 at least 30% animal glue by dry weight dictates that relatively clear and pure animal glue is preferably used.

In water, solutions of animal glues based on hide which are typically the higher gram strength variety preferred for use

25 in this invention instead of bone based glues are generally reaction neutral and have a pH range of 6.4 - 7.4 which is a pH that makes them compatible with many other materials. The specific gravity of dry animal glue is approximately 1.27.

- 30 An important feature of animal glue in the present invention is that when dry animal glue is placed in cold water like an ice chest for beverages, animal glues do not dissolve readily but swell absorbing considerable water forming a gel
- 35 state and must be heated to dissolve into solution at 100 - 140 °F. The rapid development of a gel state when wet with an aqueous medium provides a fast set and tackiness with quick development of initial bond and holding strength which is critical for the successful application of polymeric
- 40 labels to glass, plastic and metal containers using wet

5 labeling techniques. For applications where long term
contact with water and subsequent swelling of the animal
glue could cause a loss of adhesion, it is preferred to
crosslink the animal glue to make it moisture resistant. One
10 of the keys to this invention is maintaining the beneficial
properties of non cross-linked animal glue for label
application using at least 30% animal glue in the
activatable hydrophilic layer which is then cross-linked and
rendered moisture resistant after application by the water
containing a cross-linker or adhesive containing a cross-
15 linker which is applied when the hydrophilic layer is
activated into an adhesive. High speed labelers run from 200
- 1,200 container per minute and the cross-linking reaction
is relatively slow at even at high levels of cross-linker so
the layer can be wet, develop tack and adhesion to the
20 container to be labeled and cure to moisture resistant over
time. This time period varies depending on the activatable
layer formulation, cross-linker of choice and amount of each
component used along with the amount of water that must be
absorbed and dried. The time period can run from 12 hours to
25 14 days but stable formulations that are rendered moisture
resistant in 72 hours are adequate for most commercial
labeling applications. A key advantage of cross-linked
activated adhesives consisting predominantly of animal glue
is that when dry and rendered moisture resistant, the
30 adhesive is not impervious and hard and in fact the adhesive
layer will "give" or move slightly under high moisture
conditions and contact the surface to be labeled on drying
providing a "live" adhesive bond that takes up the
stresses and strains that normally occur under labeling and
35 drying conditions. Another key benefit of an adhesive layer
containing animal glue that forms a gel structure is that if
the surface to be labeled is cool, the animal glue component
will gel faster and set a bond faster because it is less
fluid. This can be an important factor in brewery
40 applications where post mold labeling of cold beer or cold

5 storage of labeled containers can accelerate the bond of the
activatable layer.

Another important feature of animal glue layers,
particularly those deposited from water or wet with water is
10 that when dry, they exhibit high adhesive strength, are
continuous, non-crystallizing, non-cracking and of great
strength and elasticity. Additionally, animal glue is
reaction neutral, relatively odorless, non toxic and non
corrosive. Due to its unique protein structure, animal glue
15 is not precipitated by acids or alkali's and is resistant to
structural breakdown by acids or alkali's within normal
practical limits so for use as a labeling adhesive where the
contents of a container could leak or drip down the side of
the container and attack the adhesive, animal glue is
20 durable. Animal glue based adhesives are also resistant to
grease, oil, alcohol and other chemicals that are free of
water and as stated above, to overcome moisture sensitivity,
animal glue can be rendered moisture resistant by cross-
linking.

25.

For glass containers, it is preferred to use high gram
strength animal glues at a level of at least 50% dry by
weight of the activatable hydrophilic layer to achieve a
30 strong bond where the gram strength of the animal glue is
greater than 50 grams. More preferably, for glass containers
a dry level of animal glue between 50 - 80% is preferred as
is a gram strength in excess of 200 grams (also known as gel
strength). The higher the gel strength of the animal glue,
35 the stronger the adhesive bond to glass will typically be.
Animal glue shows a specific affinity for glass and coated
glass and is ideal as a base polymer to be formulated into
an activatable hydrophilic adhesive layer because of its
strong wet tack and affinity for glass. Animal glue has such
40 a strong affinity for glass that some formulations when dry

5 and adhered to the glass will pull glass particles with it
when removed. This has been proven by those that use animal
glue to create chipped glass or frosted glass decorative
designs using animal glue allowed to dry on glass that is
subsequently removed. This high affinity and bond strength
10 to glass is why animal glue is the key component of this
invention for activatable layers on polymeric films for high
speed post mold labeling.

For plastic containers, it is recommended to blend synthetic
15 acrylic polymers which bind or absorb water and become
adhesives such as polyacrylic acid, polyacrylic acid
copolymer or carboxylated sodium polyacrylate with the
animal glue to promote adhesion to the plastic container
wall. For plastic containers, the dry animal glue level in
20 the activatable layer can range from 30 - 80% but it is
preferred at a level of 35 - 45% in combination with
synthetic polymers. Moisture sensitive synthetic polymers
that can be rendered insoluble through cross-linking can be
added at levels up to 65% dry polymer

25 Amounts of non moisture sensitive synthetic polymers can
also be added as modifiers at levels up to 50% dry polymer.
If synthetic polymers are used, they can be in the form of
solutions, dispersions and emulsions but solution polymers
30 are preferred.

In addition to synthetic resins as discussed above, animal
glue solutions are compatible with select natural resins,
modifying additives such as plasticizers, oils, fats, waxes
35 along with other adhesive materials such as casein, starch,
dextrine and gums under certain conditions.

To plasticize and increase the flexibility of animal glue
and control lay flat, modifiers such as urea, polyethylene
40 glycol, glycerin, sorbitol, cane or invert sugars or

5 combinations of the preceding are added at levels up to 20%
dry depending on the properties desired but preferably at
levels < 7% if the activatable layer is subsequently to be
reacted (cross-linked) to be rendered resistant to moisture
10 to minimize the level of non-reactive components in the
matrix of the activatable hydrophilic layer. It is noted
that urea acts as a gel dispersant to reduce the viscosity
of the gel for coating applications while it is inert in the
animal glue matrix.

15 A discussed above, a preferred aspect of the present
invention is to use cross-linkable (reactive) components in
the activating aqueous solution to react with the
hydrophilic layer that converts into an adhesive that cures
to become more moisture resistant as it dries and builds
20 adhesion to the container wall. Not only does the cross-
linking agent make the activated adhesive more moisture
resistant, it promotes adhesion to the container wall while
increasing chemical resistance to materials that may come in
contact with the adhesive layer. Examples of synthetic
25 cross-linkable materials are those which contain carboxyl
groups, hydroxyl groups or other functional group which will
react with a cross-linking agent. The cross-linking agent
can also be added to an adhesive used to wet and activate
the hydrophilic layer. When water and a cross-linking agent
30 are combined, the composition will comprise 0.005 -10% by
wt. of cross-linking agent.

The coated, extruded or coextruded activatable hydrophilic
layer converts to a wet tacky adhesive layer when wet with
35 an aqueous solution which is defined as a substance capable
of combining two surfaces by the formation of a bond. If a
light deposition of an aqueous adhesive is used as the
activating medium, the activatable hydrophilic layer bonds
to the polymeric film substrate and the glass, metal or
40 polymer of the container wall when dry.

5 The use of the properly formulated activatable hydrophilic layer for a given polymeric labeling substrate and container to be labeled will have a direct effect on the speed which the labeling line can be run. When considering the choice of the activatable material which forms the hydrophilic layer, 10 which may be applied by coating, coextrusion or extrusion, one must consider the label substrate, container to be labeled, labeling machinery, activation technique and downstream processing requirements such as filling, conveying and packing. In addition the final appearance of the label 15 such as the clear no label look or a plain opaque or metalized label must be considered in the choice of the components of the hydrophilic layer. Generally, a deposit of from 0.25 to 8 lbs./3000 square feet of the activatable hydrophilic layer, when dried, may be employed on the 20 polymeric film layer, depending on the particular material that is selected and the method that is used to apply the layer such as coating, coextrusion or extrusion.

It is critical to the successful application and use of an 25 activatable hydrophilic polymeric film label to control how the water or water based adhesive is applied to the activatable hydrophilic layer, how deposition (weight or thickness) is controlled and how the resultant combination with the container is pressed together. Generally, from 0.05 30 to 2.5 g. /sq. ft. of activating medium (water or water based adhesive) is applied to the pre-applied activatable hydrophilic layer with 100% coverage of the label. If a grid or other pattern of activating medium is employed, then the amount of activating medium may be reduced. If a grid 35 pattern is employed, the hydrophilic layer may be applied to be substantially in register with the activating medium.

It is critical to the successful application and use of an activatable hydrophilic polymeric film label to precisely 40 control how the amount of aqueous activating fluid medium

5 (water, water plus a cross-linker, adhesive or adhesive plus
a cross linker) is applied. Too much aqueous medium for a
given deposition of activatable hydrophilic layer will
overpower the layer and will result in loss of tack and
initial adhesion and will result in labels "swimming" or
10 moving as the labeled container is conveyed, filled or
packed and will increase the drying time of the activated
layer to produce a firm adhesive bond to the wall of the
labeled container. Not enough aqueous activating medium will
not completely develop the full adhesive properties of the
15 activatable layer and will result in poor bonds. As with any
adhesive labeling technique, the type of bond achieved is a
fine balance between the container surface to be labeled,
the label material, adhesive formulation which in this case
is the activatable hydrophilic layer in combination with the
20 aqueous activating fluid and the deposition of the activated
adhesive. For purposes of this invention, the adhesive layer
is the combination of the activatable hydrophilic
formulation and the activating medium whether it is water,
water and a cross-linking agent, adhesive or adhesive and a
25 cross-linking agent. The ultimate adhesion properties are
controlled by the choice of adhesive layer formulation and
deposition of the adhesive layer

30 When using an adhesive or adhesive and cross-linker as the
activating fluid, it will generally be possible to reduce
the typical amount of adhesive applied to the activatable
hydrophilic layer of the label to an amount which is <40% of
the amount that is typically employed for affixing paper
35 labels to a surface and preferably less than 20%. For
example from 0.02 g. to 0.7 g. /sq. cm. may be used for the
preparation of labels manufactured from polymeric films with
a thickness range from 1.5 to 8 mils.

5 The choice of the adhesive layer made up of the activatable
hydrophilic layer and activating medium, the type of label
substrate and container to be adhered together, the plant
processing conditions after labeling, storage requirements
10 and the end use requirements that must be met such as high
temperature resistance, ice proofness or passing a 24 - 72
hour ice bath soak are important considerations. There are
many more specific variables within these considerations all
of which influence the formulation of the proper activatable
hydrophilic layer and activating medium for a specific
15 application.

The bonding of the activatable layer can be accomplished
with mechanical (non smooth surfaces) and specific adhesion.
It has been found that the preferred animal glue component
20 of the activatable layer provides superior adhesion
characteristics when the layer is activated by water or a
water based adhesive containing a cross-linking agent or a
combination of cross-linking agents such as zirconium salts
of mineral acids, such as Bacote 20 from Magnesium Elektron,
25 Inc., water soluble polyamide-epichlorohydrin material such
as Polycup 172 from Hercules, Glyoxal available from BASF
Corporation or an aldehyde donor such as Glutaraldehyde that
rapidly cross-links the animal glue and the like which may
be used at a level of 0.01-8% by weight of the activatable
30 layer composition.

Mechanical adhesion is defined as the bonding between
surfaces in which the adhesive holds the parts together by
inter-locking action and actual physical penetration.
35 Specific adhesion is the bonding between surfaces which are
held together by molecular forces wherein the surfaces are
non porous and no penetration is possible. These forces are
related to the polarity and size of the molecules, pore size
of non smooth surfaces and the initial action in obtaining a
40 bond when the activated surface is wet, becomes tacky and a

5 bond develops through molecular forces.

In mechanical as well as specific adhesion, the activated hydrophilic layer must "wet" both surfaces completely or weak bonded areas will develop as it dries or "sets" resulting in a poor bond. Not only is wetting of the surfaces critical, penetration is also important and this is why a polymeric film that is cavitated, voided or porous on the activatable side is a preferred embodiment of the invention in combination with the activatable hydrophilic layer which is penetrated to a degree by the aqueous activating medium. Penetration is important since most combinations of surfaces to be adhered together involve at least one porous or absorptive surface which controls the "setting" characteristics. The preferred low density polymeric labels are made of polypropylene which is commercially available. The preferred density is 0.45 to 0.85; an especially preferred density is 0.50 to 0.65, as distinguished from the conventional polypropylene label stock which has a density above 0.9. These materials are sometimes referred to as cavitated, micro voided or foamed polypropylene. Other polymers which may be used include polyethylene, polyester, polystyrene, cellophane, polycarbonate or compatibilized polymer blends. It is preferred to utilize a low density polymeric label substrate in conjunction with a hydrophilic material such as the activatable hydrophilic layer on the polymeric label to allow for more rapid escape of water from the activating medium that is placed on the activatable hydrophilic layer on the back or adhesive side of the low density polymeric label. One common technique to create cavitation or voids in a stretched polymeric film is to use incompatible particles that separate and create a void or pore as the polymeric film is stretched. A common particle used for creating cavitation or pores is calcium carbonate and animal glues have a strong affinity and bond for calcium carbonate that

5 is typically found in many voided polymeric film layers the
activatable adhesive composition will be applied to so it
will have superior adhesion.

10 For non porous polymeric film substrates, to facilitate
wetting of the surface and penetration, the activatable
hydrophilic layer and activating fluid that combine into the
adhesive must wet out the surface of the container to be
labeled. This is accomplished by applying the activating
15 medium to the selected activatable hydrophilic layer which
when applied to the container to be labeled brings the
hydrophilic layer activated into an adhesive and container
wall into intimate molecular contact. By using an aqueous
fluid activating medium that wets and penetrates the
hydrophilic layer as well as the container surface, a fluid
20 region is created that flows to cover the surface as
completely as possible. This is critical to the invention
where even an apparently smooth surface in reality is
composed of a random network of hills and valleys. When the
activated hydrophilic layer is in the wet condition, it
25 serves as a wetting bridge to promote adhesion.

As previously mentioned, various commercially available
adhesives at significantly reduced coat weight can be used
as the aqueous activating medium with activatable
30 hydrophilic layers to provide good adhesion of polymeric
film layers to a plastic or glass surface. These materials
include starch based adhesives or casein based adhesives now
predominantly used for glass applications since they do not
bond well to plastic or metal. Specific adhesives that may
35 be employed include EVA based materials which have free
carboxyl groups, converted starch solutions, PVA based
adhesives, casein based adhesives, synthetic resin
dispersions for metal or plastic containers or blends of
synthetic and starch based products and the like.

40

5 Optionally, if just water or water and a cross-linking agent
are used as the activating medium, it is preferred to
thicken the water or solution for better machining on the
labeler that is designed to handle higher viscosity mediums
such as conventional labeling adhesives. Many commercially
10 available thickeners can be used but special mention is made
of the Laponite family of synthetic thickeners from Southern
Clay Products that form a gel structure of an aqueous
solution at low addition levels that will not overpower the
adhesive properties of the activated medium and will not
15 interfere with the ultimate bond or moisture sensitivity of
the dry adhesive at the low levels used to thicken the
aqueous solution.

It is clear that one specific activatable hydrophilic layer
20 may not fit all applications but it has been found that the
activatable hydrophilic layers of the present invention can
be tailored to particular applications based on the
conditions and requirements for wet PML labeling of
polymeric substrates but the activatable layer must contain
25 at least 30% by weight of the dry activatable layer of
animal glue that when activated (wet) by an activating fluid
medium becomes sufficiently tacky to adhere a polymeric
layer to a container through filling, conveying, processing
or packing that will subsequently dry and provide good
30 adhesion to the container. When working with natural and
synthetic activatable layers that are obviously sensitive to
moisture, it is important depending on the moisture
sensitivity of the formulation to add a humectant to the
activatable layer at a level of 0.25-10% by dry weight to
35 provide curl resistance and to impart lay flat properties to
the polymeric film labels. The humectants also tend to act
as plasticizing agents so the activatable layer does not
become too brittle when dry and include urea, polyethylene
glycols such as PEG400, polyvinyl alcohol, glycerin,
40 sorbitol and the like.

5

For a coextruded product, if an adhesion promoting tie layer is employed, materials such as maleic anhydride, ethyl acrylic acid and the like may be employed at levels up to 5% by weight of the hydrophilic composition. For a coated

10 product, if a primer is employed, materials such as chlorinated polypropylene, polyethylene imine (PEI), acrylic primers and the like may be employed at levels of 0.05-1.0 lbs/3000 sq. ft. Special mention is made of acrylic resin based primers that are filled with a silicate such as
15 colloidal silica also known as "water glass" that has demonstrated superior adhesion characteristics to animal glue that has a high natural affinity for glass and silicates such as alkali metal silicates.

20 Slip aids and anti-blocking compounds commonly used in the art can prevent excessive friction between the activatable hydrophilic layer and the printed label face and also control the effect of ambient moisture levels which may tend to cause label blocking and interfere with the operation of
25 high speed automated machinery which is used to apply labels. These materials may be used at a level of 0.2-5% by weight of the activatable layer composition and/or the protective over coat applied over the printed indicia on the side of the label opposite the activatable layer and include
30 materials such as microcrystalline wax emulsions, erucamide dispersions, polytetrafluoroethylene compositions, silicone beads, modified silicone solutions, parafin wax emulsions, high melting polypropylene emulsions, carnauba wax emulsions, oxidized ethylene/EVA compositions, micronized
35 polyethylene wax/PTFE emulsions, micronized polypropylene, micronized fluorocarbons such as PTFE (Teflon), micronized polyethylene, silica and talc.

Protective coatings may be used to protect the exposed
40 polymer film and printed indicia of the label when applied

5 at a level of 0.25-4 lbs. /3000 sq. ft. using conventional application techniques. These materials include styrenated acrylics such as OC1043 from O.C. Adhesives Inc., urethanes such as AS455 from Adhesion Systems Inc., Flexcon Release Varnish from Flint Ink.

10

If an antistatic agent is employed in the printable over coat applied over the indicia, it may be present at a level of 0.5-3% by weight of the dry coating. These materials include quaternary ammonium salts such as Ethaquad C12, 15 sulfonated styrene maleic anhydride, sulfonated polystyrene, sulfonated vinyl toluene maleic anhydride, conductive polymers and organo modified silicones such as Silwet L77. It is noted that anti-static agents are typically not needed in the activatable layer because the high moisture content 20 of the animal glue provides exceptional static elimination properties.

Optionally, if a metalized coating of a thin metal film is deposited on the polymeric sheets or rolls, premium quality 25 decorative labels with all of the advantages set forth above will be provided.

It is clear that one specific activatable hydrophilic layer may not fit all applications but hydrophilic layers can be 30 tailored to particular applications based on the conditions and requirements for wet PML labeling of polymeric substrates.

If an adhesion promoting tie layer or primer is employed to 35 promote hydrophilic layer adhesion or adhesive adhesion, materials such as maleic anhydride, ethyl acrylic acid, carboxylated polyurethane resin and the like may be employed at levels of 0.1-3 lb/3,000 sq. ft.

5

If a cross-linking catalyst is added to the adhesion promoting tie layer, the ratio of catalyst to adhesion promoting tie layer may be an amount that is sufficient to cure the adhesion promoting tie layer. An excess of the catalyst, i.e. 5-25% in excess of the amount of the catalyst that is required to cure the adhesion promoting tie layer may be used to provide a portion of the catalyst at the interface of the adhesion tie promoter and the hydrophilic layer to increase the moisture resistance of the hydrophilic layer without decreasing the moisture absorbtivity of the hydrophilic layer. Additionally, excess catalyst can also be available to aid in curing of the adhesive.

20 Plasticizers such as n-di-octylphthalate may be employed at a level of 0.5-3% by weight of the adhesive composition to prevent the polymeric film label from losing flexibility.

25 The slip aids and anti-blocking compounds prevent excessive friction between the hydrophilic layer and the adhesive layer and also control the effect of ambient moisture levels which may tend to interfere with the operation of high speed automated machinery which is used for apply labels. These materials may be used at a level of 0.5-3% by weight of the hydrophilic composition or may be coextruded or coated with the low density film and include materials such as microcrystalline wax emulsions, erucamide disp, polytetrafluoroethylene compositions, silicone beads, modified silicone solutions, parafin wax emulsions, high melting polypropylene emulsions, carnauba wax emulsions, 35 oxidized ethylene/EVA compositions, micronized polyethylene wax/PTFE emulsions, micronized polypropylene, micronized fluorocarbons such as PTFE (Teflon), micronized polyethylene, silica and talc.

40 If an antistatic agent is employed, it may be present at a

- 5 level of 0.5-3% by weight of the hydrophilic formulation.
These materials include quaternary ammonium salts such as
Ethaquad C12, sulfonated styrene maleic anhydride,
sulfonated polystyrene, sulfonated vinyl toluene maleic
anhydride conductive polymers and organo modified silicones
10 such as Silwet 77.

- Protective coatings may be used to protect the exposed
polymer film of the label when applied at a level of 0.25-4
lbs/3000 sq. ft. using conventional application techniques.
15 These materials include styrenated acrylics such as OC1043
from O.C. Adhesives, Inc., Flexon Release Varnish from
Manders-Premier.

- If desired a humectant may be added to the hydrophilic layer
20 at a level of 0.5-3% to provide curl resistance and to
impart layflat properties to the polymeric film labels.
These humectants include urea, polyethylene glycols (such as
PEG400), polyvinyl alcohol, glycerine and the like.

5 I claim:

A process for applying a polymeric label to a glass, plastic or metal container or surface said process comprising:

- 10 (a) applying a layer of a hydrophilic solid material comprising at least 30% by dry weight of an animal glue to a polymeric label and thereafter drying said layer of hydrophilic material to form a water activatable hydrophilic layer that can be activated into a tacky fastenableable adhesive;
- 15 (b) applying a sufficient amount of water, water containing a cross-linking agent, a water based adhesive or a water based adhesive containing a cross-linking agent to said activatable hydrophilic layer to form a tacky fastenable
- 20 polymeric label;
- (c) fastening said tacky fastenable polymeric label to a glass, plastic or metal container or surface; and
- 25 (d) curing said polymeric label on said glass, plastic or metal surface or container.

Abstract

The invention provides a method for fastening a polymeric label to a glass, plastic or metal container or surface by means of a water based composition containing at least 30% by dry weight of animal glue that is activated into an adhesive by the following steps: (a) applying a layer of a hydrophilic solid material based on at least 30% by weight on protein from animal renderings to a polymeric label to form a hydrophilic layer that acts as an adhesive layer when activated with an aqueous medium; (b) applying a low deposition of water, a water based adhesive, water containing a cross-linking agent or an adhesive containing a cross-linking agent to the activatable hydrophilic layer sufficient enough to activate it into an adhesive and form a fastenable polymeric label; (c) fastening the fastenable polymeric label to a glass, plastic or metal container or surface; and (d) allowing said the polymeric label to dry on the glass, plastic or metal container or surface. Special mention is made using polymeric substrates that are optically clear or substrates that are opaque, especially where the opacity is achieved by cavitation or voiding of the substrate to produce pores or voids on the adhesive side of the label while reducing the density of the label substrate.